Searches Full Listings

Magnetic Monopole Searches

Monopole Production Cross Section — Accelerator Searches

X-SECT (cm^2)	MASS (GeV)	CHG (g)	ENERGY (GeV)	BEAM	EVTS	DOCUMENT ID		TECN
$<3.E-37$	<45.0	1.0	88–94	e^+e^-	0	PINFOLD	93	PLAS
$<3.E-37$	<41.6	2.0	88–94	e^+e^-	0	PINFOLD	93	PLAS
$<7.E-35$	<44.9	0.2–1.0	89–93	e^+e^-	0	KINOSHITA	92	PLAS
$<2.E-34$	<850	≥ 0.5	1800	$p\overline{p}$	0	BERTANI	90	PLAS
$<1.2E-33$	<800	≥ 1	1800	$p\overline{p}$	0	PRICE	90	PLAS
$<1.E-37$	<29	1	50–61	e^+e^-	0	KINOSHITA	89	PLAS
$<1.E-37$	<18	2	50–61	e^+e^-	0	KINOSHITA	89	PLAS
$<1.E-38$	<17	<1	35	e^+e^-	0	BRAUNSCH...	88B	CNTR
$<8.E-37$	<24	1	50–52	e^+e^-	0	KINOSHITA	88	PLAS
$<1.3E-35$	<22	2	50–52	e^+e^-	0	KINOSHITA	88	PLAS
$<9.E-37$	<4	<0.15	10.6	e^+e^-	0	GENTILE	87	CLEO
$<3.E-32$	<800	≥ 1	1800	$p\overline{p}$	0	PRICE	87	PLAS
$<3.E-38$		<3	29	e^+e^-	0	FRYBERGER	84	PLAS
$<1.E-31$		1,3	540	$p\overline{p}$	0	AUBERT	83B	PLAS
$<4.E-38$	<10	<6	34	e^+e^-	0	MUSSET	83	PLAS
$<8.E-36$	<20		52	pp	0	[1] DELL	82	CNTR
$<9.E-37$	<30	<3	29	e^+e^-	0	KINOSHITA	82	PLAS
$<1.E-37$	<20	<24	63	pp	0	CARRIGAN	78	CNTR
$<1.E-37$	<30	<3	56	pp	0	HOFFMANN	78	PLAS
			62	pp	0	[1] DELL	76	SPRK
$<4.E-33$			300	p	0	[1] STEVENS	76B	SPRK
$<1.E-40$	<5	<2	70	p	0	[2] ZRELOV	76	CNTR
$<2.E-30$			300	n	0	[1] BURKE	75	OSPK
$<1.E-38$			8	ν	0	[3] CARRIGAN	75	HLBC
$<5.E-43$	<12	<10	400	p	0	EBERHARD	75B	INDU
$<2.E-36$	<30	<3	60	pp	0	GIACOMELLI	75	PLAS
$<5.E-42$	<13	<24	400	p	0	CARRIGAN	74	CNTR
$<6.E-42$	<12	<24	300	p	0	CARRIGAN	73	CNTR
$<2.E-36$		1	.001	γ	0	[2] BARTLETT	72	CNTR
$<1.E-41$	<5		70	p	0	GUREVICH	72	EMUL
$<1.E-40$	<3	<2	28	p	0	AMALDI	63	EMUL
$<2.E-40$	<3	<2	30	p	0	PURCELL	63	CNTR
$<1.E-35$	<3	<4	28	p	0	FIDECARO	61	CNTR
$<2.E-35$	<1	1	6	p	0	BRADNER	59	EMUL

[1] Multiphoton events.
[2] Cherenkov radiation polarization.
[3] Re-examines CERN neutrino experiments.

Monopole Flux — Cosmic Ray Searches

FLUX ($cm^{-2}sr^{-1}s^{-1}$)	MASS (GeV)	CHG (g)	COMMENTS ($\beta = v/c$)	EVTS	DOCUMENT ID		TECN
$<5.6E-15$		1	$1.8E-4 < \beta < 3.E-3$	0	[4] AHLEN	94	MCRO
$<8.7E-15$		1	$>2.E-3$	0	THRON	92	SOUD
$<4.4E-12$		1	all β	0	GARDNER	91	INDU
$<7.2E-13$		1	all β	0	HUBER	91	INDU
$<3.7E-15$	$>E12$	1	β=1.E−4	0	[5] ORITO	91	PLAS
$<3.2E-16$	$>E10$	1	$\beta > 0.05$	0	[5] ORITO	91	PLAS
$<3.2E-16$	$>E10$–E12	2, 3		0	[5] ORITO	91	PLAS
$<3.8E-13$		1	all β	0	BERMON	90	INDU
$<5.E-16$		1	$\beta < 1.E-3$	0	[6] BEZRUKOV	90	CHER
$<1.8E-14$		1	$\beta > 1.1E-4$	0	[7] BUCKLAND	90	HEPT
$<1E-18$			$3.E-4 < \beta < 1.5E-3$	0	[8] GHOSH	90	MICA
$<7.2E-13$		1	all β	0	HUBER	90	INDU
$<5.E-12$	$>E7$	1	$3.E-4 < \beta < 5.E-3$	0	BARISH	87	CNTR
$<1.E-13$			$1.E-5 < \beta < 1$	0	[6] BARTELT	87	SOUD
$<1.E-10$		1	all β	0	EBISU	87	INDU
$<2.E-13$			$1.E-4 < \beta < 6.E-4$	0	MASEK	87	HEPT
$<2.E-14$			$4.E-5 < \beta < 2.E-4$	0	NAKAMURA	87	PLAS
$<2.E-14$			$1.E-3 < \beta < 1$	0	NAKAMURA	87	PLAS
$<5.E-14$			$9.E-4 < \beta < 1.E-2$	0	SHEPKO	87	CNTR
$<2.E-13$			$4.E-4 < \beta < 1$	0	TSUKAMOTO	87	CNTR
$<5.E-14$		1	all β	1	[9] CAPLIN	86	INDU
$<5.E-12$		1		0	CROMAR	86	INDU
$<1.E-13$		1	$7.E-4 < \beta$	0	HARA	86	CNTR
$<7.E-11$		1	all β	0	INCANDELA	86	INDU
$<1.E-18$			$4.E-4 < \beta < 1.E-3$	0	[8] PRICE	86	MICA
$<5.E-12$		1		0	BERMON	85	INDU
$<6.E-12$		1		0	CAPLIN	85	INDU
$<6.E-10$		1		0	EBISU	85	INDU
$<3.E-15$			$5.E-5 \leq \beta \leq 1.E-3$	0	[6] KAJITA	85	CNTR
$<2.E-21$			$\beta < 1.E-3$	0	[6,10] KAJITA	85	CNTR
$<3.E-15$			$1.E-3 < \beta < 1.E-1$	0	[6] PARK	85B	CNTR
$<5.E-12$		1	$1.E-4 < \beta < 1$	0	BATTISTONI	84	NUSX
$<7.E-12$		1		0	INCANDELA	84	INDU
$<7.E-13$		1	$3.E-4 < \beta$	0	[7] KAJINO	84	CNTR
$<2.E-12$		1	$3.E-4 < \beta < 1.E-1$	0	KAJINO	84B	CNTR
$<6.E-13$		1	$5.E-4 < \beta < 1$	0	KAWAGOE	84	CNTR
$<2.E-14$			$1.E-3 < \beta$	0	[6] KRISHNA...	84	CNTR
$<4.E-13$		1	$6.E-4 < \beta < 2.E-3$	0	LISS	84	CNTR
$<1.E-16$			$3.E-4 < \beta < 1.E-3$	0	[8] PRICE	84	MICA
$<1.E-13$		1	$1.E-4 < \beta$	0	PRICE	84B	PLAS
$<4.E-13$		1	$6.E-4 < \beta < 2.E-3$	0	TARLE	84	CNTR
				7	[11] ANDERSON	83	EMUL
$<4.E-13$		1	$1.E-2 < \beta < 1.E-3$	0	BARTELT	83B	CNTR
$<1.E-12$		1	$7.E-3 < \beta < 1$	0	BARWICK	83	PLAS
$<3.E-13$		1	$1.E-3 < \beta < 4.E-1$	0	BONARELLI	83	CNTR
$<3.E-12$			$5.E-4 < \beta < 5.E-2$	0	[6] BOSETTI	83	CNTR
$<4.E-11$		1		0	CABRERA	83	INDU
$<5.E-15$		1	$1.E-2 < \beta < 1$	0	DOKE	83	PLAS
$<8.E-15$			$1.E-4 < \beta < 1.E-1$	0	[6] ERREDE	83	CNTR
$<5.E-12$		1	$1.E-4 < \beta < 3.E-2$	0	GROOM	83	CNTR
$<2.E-12$			$6.E-4 < \beta < 1$	0	MASHIMO	83	CNTR
$<1.E-13$		1	β=3.E−3	0	ALEXEYEV	82	CNTR
$<2.E-12$		1	$7.E-3 < \beta < 6.E-1$	0	BONARELLI	82	CNTR
$6.E-10$		1	all β	1	[12] CABRERA	82	INDU
$<2.E-11$			$1.E-2 < \beta < 1.E-1$	0	MASHIMO	82	CNTR
$<2.E-15$			concentrator	0	BARTLETT	81	PLAS
$<1.E-13$	>1		$1.E-3 < \beta$	0	KINOSHITA	81B	PLAS
$<5.E-11$	$<E17$		$3.E-4 < \beta < 1.E-3$	0	ULLMAN	81	CNTR
$<2.E-11$			concentrator	0	BARTLETT	78	PLAS
$1.E-1$	>200	2		1	[13] PRICE	75	PLAS
$<2.E-13$		>2		0	FLEISCHER	71	PLAS
$<1.E-19$		>2	obsidian, mica	0	FLEISCHER	69C	PLAS
$<5.E-15$	<15	<3	concentrator	0	CARITHERS	66	ELEC
$<2.E-11$		<1–3	concentrator	0	MALKUS	51	EMUL

[4] AHLEN 94 limit for dyons extends down to β=0.9E−4 and a limit of 1.3E−14 extends to β = 0.8E−4.
[5] ORITO 91 limits are functions of velocity. Lowest limits are given here.
[6] Catalysis of nucleon decay; sensitive to assumed catalysis cross section.
[7] Used DKMPR mechanism and Penning effect.
[8] Assumes monopole attaches fermion nucleus.
[9] Limit from combining data of CAPLIN 86, BERMON 85, INCANDELA 84, and CABRERA 83. For a discussion of controversy about CAPLIN 86 observed event, see GUY 87. Also see SCHOUTEN 87.
[10] Based on lack of high- energy solar neutrinos from catalysis in the sun.
[11] Anomalous long-range α (^{4}He) tracks.
[12] CABRERA 82 candidate event has single Dirac charge within $\pm$5%.
[13] ALVAREZ 75, FLEISCHER 75, and FRIEDLANDER 75 explain as fragmenting nucleus. EBERHARD 75 and ROSS 76 discuss conflict with other experiments. HAGSTROM 77 reinterprets as antinucleus. PRICE 78 reassesses.

Monopole Flux — Astrophysics

FLUX ($cm^{-2}sr^{-1}s^{-1}$)	MASS (GeV)	CHG (g)	COMMENTS ($\beta = v/c$)	EVTS	DOCUMENT ID		TECN
$<1.E-16$	E17	1	galactic field	0	[14] ADAMS	93	COSM
$<1.E-23$			Jovian planets		[15] ARAFUNE	85	COSM
$<1.E-16$	E15		solar trapping	0	BRACCI	85B	COSM
$<1.E-18$		1		0	[15] HARVEY	84	COSM
$<3.E-23$			neutron stars		KOLB	84	COSM
$<7.E-22$			pulsars	0	[15] FREESE	83B	COSM
$<1.E-18$	$<E18$	1	intergalactic field	0	[15] REPHAELI	83	COSM
$<1.E-23$			neutron stars	0	[15] DIMOPOUL...	82	COSM
$<5.E-22$			neutron stars	0	[15] KOLB	82	COSM
$<5.E-15$	$>E21$		galactic halo		SALPETER	82	COSM
$<1.E-12$	E19	1	β=3.E−3	0	[16] TURNER	82	COSM
$<1.E-16$		1	galactic field	0	PARKER	70	COSM

[14] ADAMS 93 limit based on "survival and growth of a small galactic seed field" is 10^{-16} ($m/10^{17}$ GeV) $cm^{-2}s^{-1}sr^{-1}$. Above 10^{17} GeV, limit 10^{-16} (10^{17} GeV/m) $cm^{-2}s^{-1}sr^{-1}$ (from requirement that monopole density does not overclose the universe) is more stringent.
[15] Catalysis of nucleon decay.
[16] Re-evaluates PARKER 70 limit for GUT monopoles.

Monopole Density — Matter Searches

DENSITY	CHG (g)	MATERIAL	EVTS	DOCUMENT ID		TECN
$<2.E-7$/gram	>0.6	Fe ore	0	[17] EBISU	87	INDU
$>1.E-14$/gram	$>1/3$	iron aerosols	>1	MIKHAILOV	83	SPEC
$<6.E-4$/gram		air, seawater	0	CARRIGAN	76	CNTR
$<5.E-1$/gram	>0.04	11 materials	0	CABRERA	75	INDU
$<2.E-4$/gram	>0.05	moon rock	0	ROSS	73	INDU
$<6.E-7$/gram	<140	seawater	0	KOLM	71	CNTR
$<1.E-2$/gram	<120	manganese nodules	0	FLEISCHER	69	PLAS
$<1.E-4$/gram	>0	manganese	0	FLEISCHER	69B	PLAS
$<2.E-3$/gram	<1–3	magnetite, meteor	0	GOTO	63	EMUL
$<2.E-2$/gram		meteorite	0	PETUKHOV	63	CNTR

[17] Mass 1×10^{14}–1×10^{17} GeV.

Monopole Density — Astrophysics

DENSITY	CHG (g)	MATERIAL	EVTS	DOCUMENT ID		TECN
$<1.E-9$/gram	1	sun, catalysis	0	[18] ARAFUNE	83	COSM
$<6.E-33$/nucl	1	moon wake	0	SCHATTEN	83	ELEC
$<2.E-28$/nucl		earth heat	0	CARRIGAN	80	COSM
$<2.E-4$/prot		42cm absorption	0	BRODERICK	79	COSM
$<2.E-13/m^3$		moon wake	0	SCHATTEN	70	ELEC

[18] Catalysis of nucleon decay.